

# Guidance, Navigation, and Control System for Maneuverable Pico-Satellites, Phase I

Completed Technology Project (2009 - 2010)



## Project Introduction

A compact, low-power GN&C system is essential to the success of pico-satellite Automated Rendezvous and Docking (AR&D). Austin Satellite Design (ASD) proposes to deliver a working design of an integrated six-degree-of-freedom (DOF) Guidance, Navigation, and Control (GN&C) system for pico-satellites at the conclusion of Phase 1 of this STTR. A six DOF translation and rotation determination and control system will be designed for a pico-satellite form-factor to generate the onboard guidance and control necessary to demonstrate autonomous control stability and perform simple proximity maneuvers. An existing NASA/JSC GPS receiver will be utilized for navigation. Added sensors, such as a magnetometer, will be combined with GPS signals for attitude determination. A thruster actuator concept will be identified and a design produced that satisfies anticipated operational requirements and that fits within the mass and power constraints of the pico-satellite mission. Flight hardware will not be procured until Phase 2; however, component characteristics will be documented and modeled during Phase 1 and GN&C algorithms will be written to include them. Software that can be deployed to embedded systems will be written and validated in simulation. At the conclusion of Phase 1, simulated GN&C will be demonstrated within a pico-satellite form factor using embedded software such that a Technology Readiness Level (TRL) of 3 or 4 is achieved.

## Anticipated Benefits

When combined with related technologies, the GN&C and communications systems that are proposed for Phase 1 and Phase 2 will offer an attractive core system for multiple customers. These will include the US Department of Defense, and the increasing number of cubesat projects that require attitude control and those that will require AR&D in the years ahead. Formation flying experiments and commercial ventures that propose dense satellite clusters as measurement platforms will need stationkeeping and maneuvering capabilities in very small form factors to manage launch vehicle costs. The Phase 1 and Phase 2 efforts proposed here will result in enabling technologies for automated rendezvous and docking of pico-satellites including a robust GN&C system and (after Phase 2) a miniaturized, space-qualified communications system useful for inter-satellite crosslink, uplink, and downlink. These may include future Low Earth Orbit formation flying projects such as space weather and environmental monitoring missions.



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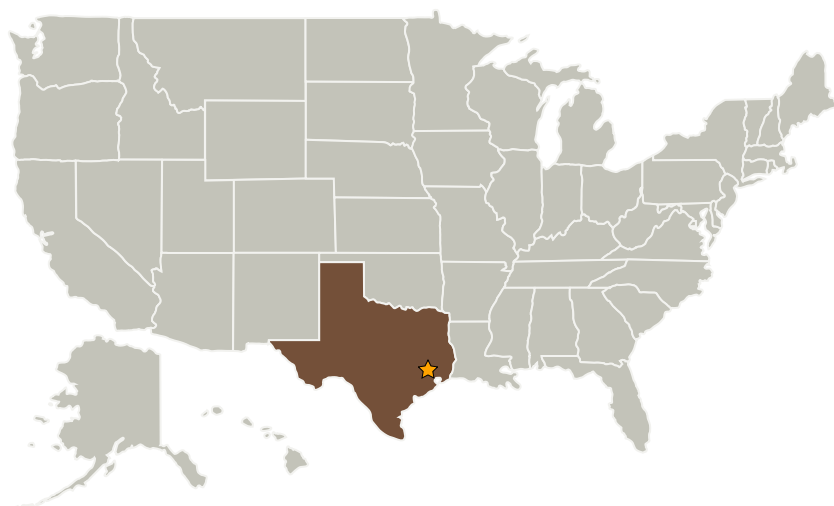
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Austin Satellite Design	Supporting Organization	Industry	Austin, Texas
The University of Texas at Austin	Supporting Organization	Academia	Austin, Texas

## Primary U.S. Work Locations

Texas

## Project Transitions

 **January 2009:** Project Start **January 2010:** Closed out

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Johnson Space Center (JSC)

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Project Manager:**

Robert S Provence

**Principal Investigator:**

E. Glenn Lightsey

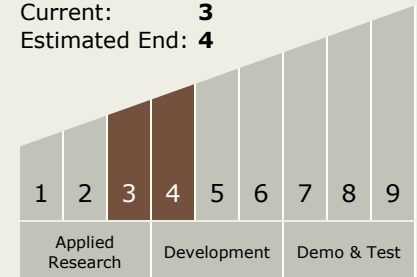
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## Technology Maturity (TRL)

Start: **3**  
Current: **3**  
Estimated End: **4**



## Technology Areas

### Primary:

- TX09 Entry, Descent, and Landing
  - └ TX09.4 Vehicle Systems
    - └ TX09.4.7 Guidance, Navigation and Control (GN&C) for EDL